

**TITLE OF THE INVENTION**

**[0100]**     Stacked Assembly of Roofing Caps

**INVENTOR**

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**CROSS-REFERENCE TO RELATED APPLICATIONS**

**[0300]**     This application is a continuation-in-part of pending U.S. Non-Provisional Application 10/435,737 (filed May 9, 2003), also entitled "Stacked Assembly of Roofing Caps" and fully included herein by reference, and claims priority benefit thereof and of the parent applications of said Application 10/435,737. Application 10/435,737, in turn, was a division of pending U.S. Non-Provisional Application 09/648,335 (filed August 25, 2000), entitled "Staple or Nail Gun Assembly, Cap Gun Feeding Device for Staple or Nail Gun, and Cap Assembly" and fully included herein by reference, and claims priority benefit thereof and of the parent applications of said Application 09/648,335. Application 09/648,335, in turn, was a continuation-in-part of U.S. Non-Provisional Application 09/438,983 (filed November 12, 1999), entitled "Staple or Nail Gun Assembly, Cap Feeding Device for Staple or Nail Gun, and Cap Assembly" and claimed priority benefit of said Application 09/438,983, which has now issued as U.S. Patent No. 6,302,310 (issued October 16, 2001). Application 09/648,335 also claimed priority benefit of U.S. Provisional Application 60/150,534 (filed August 25, 1999), entitled "Stacked Felt Caps for the Rapid Feeding Felt Cap Gun," and also claimed priority benefit of U.S. Provisional Application 60/160,672 (filed October 21, 1999), entitled "Stacked Feltpcaps Held Together with Plastic Line or Wire or Tube." Application 09/438,983, in turn, claimed priority of U.S. Provisional Application

1 60/108,174 (filed November 13, 1998), entitled "Rapid Feeding Felt Cap Gun & Felt Caps  
2 Glued Together."

3 STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR  
4 DEVELOPMENT

5 [0400] Not applicable.

6 REFERENCE TO COMPACT DISC(S)

7 [0500] Not applicable.

8 FIELD OF THE INVENTION

9 [0600] This invention relates to a cap feeding device for a staple or nail gun, as well as a  
10 staple or nail gun assembly and a cap assembly for use with a cap feeding device.

11 BACKGROUND OF THE INVENTION

12 [0700] Automatic nail guns, powered by compressed air or electricity, are used, for  
13 example, to attach roofing material, such as tarpaper, to the roof of a house. A generally flat  
14 cap is often used with each nail. A nail penetrates the cap and the tarpaper and protrudes into  
15 the underlying roof structure, attaching the roofing material to the roof surface.

16 [0800] Typically, an operator must manually place and hold a cap under the nose of a  
17 nail gun and then trigger the gun to drive a nail through the cap into the roof structure. The  
18 manual placement of caps presents a serious safety hazard to the operator because the  
19 operator's hand is close to the nose of the gun when a nail is driven through the nose of the  
20 gun. In addition, manual placement of caps is time-consuming and inefficient.

21 [0900] A cap feeding device may be employed to reduce the risk associated with manual  
22 placement of caps and to improve the efficiency of roofing operation. The cap feeding  
23 device automatically places a cap under the nose of a nail gun, and then the nail gun drives a  
24 nail through the cap and into the underlying roof structure.

25 [1000] A conventional cap feeding device generally includes a cap container and a base

1 having a channel. The base extends between the cap container and a position under the nose  
2 of the nail gun. Caps are fed into the channel of the base from the cap container and pushed  
3 to the position under the nose of the nail gun. When the gun is triggered, a nail penetrates  
4 and dislodges the cap under the nose of the nail gun and protrudes into the underlying roof  
5 structure. The feeding of the caps under the nose of the nail gun is coordinated with the  
6 ejection of the nails through the nose of the nail gun, so that a cap is placed under the nose of  
7 the gun before the gun is triggered to expel a nail.

8 [1100] Conventional cap feeding devices have a number of drawbacks. For example,  
9 conventional cap feeding devices are generally heavy, putting additional stress on the  
10 operator's hand holding the nail gun. Also, many conventional cap feeding devices can only  
11 be installed close to the front end of a nail gun, making the nail gun not only heavy but also  
12 unbalanced with most of the weight placed at the front end of the gun. This makes the nail  
13 gun difficult to handle and may put stress on the operator's hand and wrist. In addition, with  
14 so many components placed near the nose of the gun, it is difficult to see the position of the  
15 nose of the gun, making a precise placement of a nail difficult.

16 [1200] The conventional cap feeding devices are installed close to the front end of the  
17 gun because designers need to place a conventional cap container close to the nose of the gun  
18 to reduce the weight of the cap feeding device. The reason is that in many devices a cap is  
19 pushed directly from the cap container to a position under the nose of the nail gun. Thus, if  
20 the cap container is far from the nose of the gun, a long shuttle is needed to push a cap from  
21 the container to the position under the nose of the nail gun through the channel of the base.  
22 In addition, an actuator, such as an air cylinder, with a long displacement is also needed to  
23 drive the shuttle. The displacement of the actuator should be about the same as the distance  
24 between the cap container and the nose of the nail gun. A long shuttle and actuator increase  
25 the weight and size of the cap feeding device. With the cap feeding device placed near the  
26 nose of the gun, the shuttle and actuator, thus the cap feeding device can be made lighter,  
27 smaller and less expensive.

1   **[1300]**     Caps for automatic nailing guns are available in a wide variety of shapes and  
2   packaging. Most caps for felt roofing products are sold in bulk and must be applied  
3   singularly with each nailing operation. Automatic nailers for roofing including magazines  
4   containing caps are available, however, for a variety of reasons, have not found wide usage.  
5   Most of the disadvantages of nailers including magazines of roofing caps are related to the  
6   unwieldiness of the apparatus, and somewhat to the lack of reliability or uniformity of  
7   operation. Automatic nailing machines adapted for installing roofing caps are illustrated in  
8   such as patents 5,947,362 to Omli; 5,445,297; 5,184,752; and 5,042,142. None of these prior  
9   automatic roofing nailers provide the versatility and ease of usage, incorporate the use of an  
10   inventive roofing cap or disclose a convenient packaging of stacked caps which may be  
11   readily inserted into the magazine of an automatic roofing nailer. Not only does the cap of  
12   the present invention lend itself to convenient packaging, but it also provides superior  
13   reliability in its ability to be routinely fed through the magazine chamber of the nailing  
14   machine for reliable operation, but the configuration which provides the fit, reliability and  
15   stackability also provides a cap which delivers superior performance in holding the material  
16   to be attached such as roofing felt to the roof or siding materials.

## 17   SUMMARY OF THE INVENTION

18   **[1400]**     This invention provides a compact, light-weight cap feeding device that  
19   overcomes the problems associated with conventional nail guns and cap feeding devices.

20   **[1500]**     In accordance with one aspect of the invention, a device, which is used to feed,  
21   staple or nail caps having a diameter, includes a base, a container and a shuttle. The base  
22   includes cap feeding and cap holding chambers, and a channel connecting the two chambers.  
23   The distance between the cap feeding and cap holding chambers is at least twice the diameter  
24   of the caps. The container has a generally cylindrical configuration and is substantially  
25   perpendicular to the base. The container is operatively associated with the cap feeding  
26   chamber and is adapted to feed caps stored in the container into the cap feeding chamber one

1 cap at a time. The shuttle is adapted to slide within the channel of the base and is adapted to  
2 move a cap at the cap feeding chamber through the channel towards the cap holding chamber  
3 by a distance equal to a diameter of the cap.

4 **[1600]** In accordance with another aspect of the invention, a staple or nail gun assembly  
5 includes a staple or nail gun and a cap feeding device. The staple or nail gun has a head  
6 portion and a handle portion. The head portion has an opening through which a staple or nail  
7 is expelled. The handle portion has first and second ends, the first end being attached to the  
8 head portion. The cap feeding device includes a base, a container and a shuttle. The base  
9 includes cap feeding and cap holding chambers, and a channel connecting the two chambers.  
10 The distance between the cap feeding and cap holding chambers is at least twice the diameter  
11 of the caps. The container has a generally cylindrical configuration and is substantially  
12 perpendicular to the base, facilitating the transfer of caps from the container to the cap  
13 feeding chamber. The container is operatively associated with the cap feeding chamber and  
14 is adapted to feed caps stored in the container into the cap feeding chamber one cap at a time.  
15 The shuttle is adapted to slide within the channel of the base and is adapted to move a cap at  
16 the cap feeding chamber through the channel towards the cap holding chamber by a distance  
17 equal to a diameter of the cap.

18 **[1700]** In accordance with a further aspect of the invention, a cap assembly for use with a  
19 cap feeding device includes a plurality of concentrically stacked staple or nail caps. Each cap  
20 has two opposite surfaces, and at least one of the surfaces of each cap is attached to one of  
21 the surfaces of another cap.

22 **[1800]** The cap feeding device and the staple or nail gun assembly of the present  
23 invention are compact and light-weight and thus have a number of advantages over the prior  
24 art. The weight of a staple or nail gun assembly in accordance to the present invention is  
25 substantially balanced. The weight of the staple or nail gun is mostly located at the front end  
26 of the gun handle, while the weight of the cap feeding device, especially the weight of the  
27 cap container, is mostly located at the rear end of the gun handle. Further, although the cap

1 container is not placed near the nose of the gun, an actuator with a long displacement is not  
2 needed because a cap is not pushed directly from the cap feeding chamber to the cap holding  
3 chamber. The cap in the cap feeding chamber is pushed by the shuttle towards the cap  
4 holding chamber by a distance equal to the diameter of the cap (if the cap is circular). This  
5 cap pushes the cap in front of it in the channel towards the cap holding chamber by the same  
6 distance. The last cap is pushed into the cap holding chamber, where a staple or nail  
7 penetrates the cap in the cap holding chamber when the gun is triggered. In other words,  
8 there are at least three caps in the channel of the base, one at the cap feeding chamber, one at  
9 the middle position and one at the cap holding chamber. Each time after the gun is triggered,  
10 the caps are moved towards the cap holding chamber by a distance equal to the diameter of  
11 the caps. In addition, because most of the components of the cap feeding device are not  
12 located near the nose of the gun, an operator is able to see the nose of the gun better, allowing  
13 him to more precisely aim the nose of the gun.

14 **[1900]** Additional objects of the present invention are roofing caps having a disk-like  
15 circular shape including a peripheral ridge on the lower surface of the cap and a central  
16 portion being in the shape of a truncated cone exhibiting a flat plateau in the central portion  
17 of the truncated cone. Alternative embodiments of the cap include a lateral peripheral rim on  
18 the upper surface of the cap providing a complimentary surface for receiving the peripheral  
19 ridge of the adjacent stacked cap.

20 **[2000]** In accordance with still further objectives of the present invention are stacking  
21 means by which a plurality of caps may be stacked in vertical relation and retained for  
22 inventory and shipment and later inserted into the magazine of a nailing machine with a  
23 minimum of effort. Alternative embodiments of such stacking means include the caps  
24 having a hole centrally disposed in the plateau whereby a plastic cord or wire may be strung  
25 through the adjacent holes of stacked caps in which the lower portion of the cord or wire is  
26 terminated by a releasable fixture and the upper end may be terminated with such as a loop.  
27 Alternative means of stacking caps within the invention include caps having disposed thereon

1 a retaining stud on the upper or lower surface of the cap and the opposite surface having a  
2 complementary receiving hole disposed therein. Additional alternative means of stacking  
3 caps include a skewer rod through the caps or melting the caps together in a stacked  
4 assembly. The inventive caps may similarly be retained in stacks by means of an adhesive,  
5 such as a hot melt adhesive, disposed between adjacent surfaces of stacked caps.

## 6 BRIEF DESCRIPTION OF THE DRAWINGS

7 **[2100]** Figure 1 is a perspective view of a staple or nail gun assembly according to the  
8 present invention.

9 **[2200]** Figure 2 is a side view of a cap container of the embodiment shown in Figure 1,  
10 where the cover is in the open position.

11 **[2300]** Figure 3 is the side view of the cap container shown in Figure 2, where the cover  
12 is in the closed position.

13 **[2400]** Figure 4 is a rear view of the cap container shown in Figures 2 and 3.

14 **[2500]** Figure 5 is a top view of a base, a shuttle and a piston-cylinder arrangement of the  
15 embodiment shown in Figure 1.

16 **[2600]** Figure 6 is an exploded view of a mechanism for holding a cap in the cap holding  
17 chamber of the base.

18 **[2700]** Figure 7 is a top view of the shuttle shown in Figure 5.

19 **[2800]** Figure 8 is a schematic drawing of the system controlling the movement of the  
20 shuttle.

21 **[2900]** Figure 9a is a top view of a cap of the present invention.

22 **[3000]** Figure 9b is a cross sectional drawing of the cap shown in Figure 9a.

23 **[3100]** Figure 9c is a top view of an alternative embodiment of the cap of the present  
24 invention.

25 **[3200]** Figure 9d is a cross sectional drawing of the cap shown in Figure 9c.

26 **[3300]** Figure 9e is a top view of an alternative embodiment of the cap of the present

1 invention.

2 [3400] Figure 9f is a cross sectional drawing of the cap shown in Figure 9e.

3 [3500] Figure 9g is a top view of an alternative embodiment of the cap of the present  
4 invention.

5 [3600] Figure 9h is a cross sectional drawing of the cap shown in Figure 9g.

6 [3700] Figure 10 is an elevational view, partially in section of the cap shown in Figure 9f.

7 [3800] Figure 11 is an elevational view, partially in section of the cap shown in Figure 9d  
8 installed on a roof deck.

9 [3900] Figure 12 is a partial sectional elevational view of a stack of caps being fed  
10 according to the present invention.

11 [4000] Figure 13 is an elevational view of a stack of caps according to the present  
12 invention.

13 [4100] Figure 14 is an elevational view of an alternative embodiment of a stack of caps  
14 according to the present invention.

15 [4200] Figure 15 is an elevational view of an alternative embodiment of a stack of caps  
16 according to the present invention.

17 [4300] Figure 16 is a bottom view of the stack of caps shown in Figure 15.

18 [4305] Figures 17-19 show a fourth alternative embodiment of assembling a stack of caps  
19 according to the present invention.

20 [4310] Figure 17 is a side and partial sectional view of the fourth alternative  
21 embodiment.

22 [4315] Figure 18 is an enlarged view of the tip of the retaining rod of the fourth  
23 alternative embodiment.

24 [4320] Figure 19 is an enlarged view of the fourth alternative embodiment showing the  
25 piercing of the bottom cap by the tip of the retaining rod.

26 [4325] Figures 20-24 show a fifth alternative embodiment of assembling a stack of caps  
27 according to the present invention.

1 [4330] Figure 20 is a front side view of a stack of caps assembled according to the fifth  
2 alternative embodiment. The view from the back side is substantially identical.

3 [4335] Figure 21 is a top view of the stack of caps of Figure 20, taken substantially along  
4 the line 21-21 shown in Figure 20.

5 [4340] Figure 22 is an end view of the sled used in making the stack of caps assembled  
6 according to the fifth alternative embodiment, showing the lid of the sled being opened in  
7 dotted outline.

8 [4345] Figure 23 is a top view of the sled used in making the stack of caps assembled  
9 according to the fifth alternative embodiment, showing the lid of the sled opened.

10 [4350] Figure 24 is a front view of the sled of the fifth alternative embodiment shown  
11 passing between the laser melting means.

## 12 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

13 [4400] Figures 1-8 illustrate one example of the staple or nail gun assembly 10 of the  
14 present invention. The staple or nail gun assembly 10 includes a staple or nail gun 20 and a  
15 cap feeding device 40. The staple or nail gun 20 has a handle portion 22 and a head portion  
16 30. The handle portion 22 has front and rear ends 24, 26, the front end 24 being attached to  
17 the head portion 30. The cap feeding device 40 includes a base 50, a cap container 60 and a  
18 shuttle 80. The base 50 includes a cap feeding chamber 52 and a cap holding chamber 54,  
19 and a channel 56 connecting the two chambers 52, 54. The container 60 is used to store  
20 staple or nail caps 140 and to feed the caps 140 to the cap feeding chamber 52 of the base 50  
21 one cap at a time. The shuttle 80 is movably disposed in the channel 56 of the base 50 and is  
22 adapted to move a cap at the cap feeding chamber 52 towards the cap holding chamber 54  
23 through the channel 56.

24 [4500] In the preferred embodiment shown in Figure 1, the staple or nail gun 20 is an  
25 automatic nail gun powered by compressed air, although any staple or nail gun can be used  
26 with an embodiment of present invention, including a staple or nail gun powered, for

1 example, by electricity. The head portion 30 of the nail gun 20 includes a nose portion 32  
2 and a barrel having an opening 34 at the nose portion 32. The nail gun 20 may also include a  
3 nail container 36 connected to the head portion 30. The nail container 36 holds a plurality of  
4 nails and feeds the nails into the barrel one nail at a time. The head portion 30 may also  
5 include a piston-cylinder arrangement, in which a piston is movably disposed in a cylinder  
6 and divides the cylinder into first and second chambers. When the nail gun 20 is triggered,  
7 compressed air is supplied to the first chamber of the cylinder to push the piston towards the  
8 nail in the barrel. The piston strikes the nail in the barrel to eject the nail through the opening  
9 34 at the nose portion 32. Then compressed air can be supplied to the second chamber to  
10 return the piston to the retracted position. Alternatively, the piston may be returned to the  
11 retracted position with any alternative device such as a spring. Because the head portion 30,  
12 which contains most of the nail gun components, is disposed at the front end 24 of the handle  
13 portion 22, the weight of the staple or nail gun 20 is mostly placed at the front end 24 of the  
14 handle 22.

15 [4600] As stated above, the cap feeding device 40 includes a base 50, a cap container 60  
16 and a shuttle 80. The base 50 has a cap feeding chamber 52 and a cap holding chamber 54,  
17 and a channel 56 connecting the two chambers 52, 54. The container 60 is used to store nail  
18 caps 140 and to feed the caps 140 to the cap feeding chamber 52 of the base 50 one cap at a  
19 time. The shuttle 80 is operatively associated with the channel 56 of the base 50 and pushes  
20 a cap at the cap feeding chamber 52 towards the cap holding chamber 54 through the channel  
21 56.

22 [4700] As illustrated in Figures 2-4, the cap container 60 includes a hollow tubular  
23 portion 62 having first and second open ends 64, 66, and a cover 68 pivotably connected to  
24 the tubular portion 62 at the first open end 64. The second open end 66 of the tubular portion  
25 62 is aligned with the cap feeding chamber 52 of the base 50, and the caps 140 in the  
26 container 60 are fed to the cap feeding chamber 52 through the second open end 66. In this  
27 embodiment, the tubular portion 62 is attached to the base 50 with a plurality of bolts and

1 nuts. In the illustrated preferred embodiment, the tubular portion 62 is perpendicular to the  
2 base 50. The container 60 also includes a plunger 70, which may be disposed in the tubular  
3 portion 62 or disposed in the cover 68, and a spring 72, such as a ribbon spring 72 shown in  
4 Figures 2-4, pulling the plunger 70 towards the second end 66 of the tubular portion 62. The  
5 spring force biases the plunger 70 against the stack of caps 140 in the direction of the second  
6 end 66 to ensure that the outermost cap at the second end 66 is disposed in the cap feeding  
7 chamber 52 of the base 50. In the embodiment shown in Figures 2-4, the tubular portion 62  
8 includes a longitudinal slot 76 in its wall, and the plunger 70 disposed in the tubular portion  
9 62 includes a knob 78 extending to the exterior of the tubular portion 62 through the  
10 longitudinal slot 76. The cover 68 may also include a slot 82 aligned with the slot 76 of the  
11 tubular portion 62 so that the plunger 70 can be lifted into the cover 68 from the tubular  
12 portion 62 by pulling the knob 78 or a handle 84 attached to the knob 78. When the plunger  
13 70 is in the cover 68, the cover 68 can be placed in the open position, as shown in Figure 2,  
14 and the spring force keeps the cover 68 in the open position. After the cover 68 is placed in  
15 the open position, a coaxial stack of caps 140 can be disposed in the tubular portion 62. Then  
16 the plunger 70 is put back in the tubular portion 62 and the cover 68 is placed in the closed  
17 position, as shown in Figure 3.

18 [4800] In a preferred embodiment shown in Figures 9a and 9b, the caps 140 each have  
19 two opposite surfaces 142, 144 with at least one surface 142, 144 of each cap attached to a  
20 surface 142, 144 of another cap. In a preferred embodiment, the cap is circular, with a  
21 diameter of about 1 inch and a thickness of about 1/16 inch. The caps 140 can be attached to  
22 one another in several ways. For example, the caps 140 may be glued to each other, or they  
23 may be attached by friction fit. Alternatively, the stack of caps may include grooves on the  
24 opposite sides of the stack, and the caps may be held together with a string, such as a wax or  
25 plastic string, disposed on the grooves. A stack of caps 140 may include any number of caps,  
26 for example, 100 caps. A stack of caps 140 attached to each other is easier to handle and to  
27 load into the cap container 60.

1 [4900] The base 50 has a generally flat, elongated rectangular configuration and is used  
2 to transport caps 140 from the cap feeding chamber 52 to the cap holding chamber 54 under  
3 the nose 32 of the nail gun 20. The cap feeding and cap holding chambers 52, 54 are  
4 disposed respectively near the first and second ends 86, 88 of the base 50. The distance  
5 between the cap feeding and cap holding chambers 52, 54 is such that the cap feeding  
6 chamber 52 (and thus the cap container 60) is near the rear end 26 of the handle portion 22,  
7 and the cap holding chamber 54 is under the nose 32 of the nail gun 20. The cap feeding  
8 chamber 52 includes an indentation having a configuration similar to that of the caps 140 for  
9 accommodating a cap. In the illustrated embodiment, for example, the cap feeding chamber  
10 52 includes an indentation having a circular configuration which is similar to the flat circular  
11 configuration of the caps 140. The cap holding chamber 54 has a generally circular through  
12 hole having a configuration similar to that of caps 140.

13 [5000] A cap holding mechanism may be provided to hold a cap in the cap holding  
14 chamber 54 and to allow a cap to go through the cap holding chamber 54 when a nail is  
15 ejected through the nose 32 of the nail gun 20 and strikes the cap. The cap holding  
16 mechanism 53 used in the illustrated embodiment is shown in Figure 6. The cap holding  
17 mechanism 53 includes a feeding pawl 58 and a spring 57. The feeding pawl 58 and spring  
18 57 are attached to the base 50 by a bracket 55. The spring 57 presses the feeding pawl 58  
19 against a ledge 59 which extends from the bottom of the channel 56 into the circular cap  
20 holding chamber 54. As a cap is pushed into the cap holding chamber 54, the cap passes  
21 between the ledge 59 and the feeding pawl 58. When the cap is placed in the cap holding  
22 chamber 54, the feeding pawl 58 presses the cap against the ledge 59 and holds the cap in the  
23 cap holding chamber 54. When a nail is ejected through the nose 32 of the nail gun 20 and  
24 strikes the cap, the feeding pawl 58 releases the cap and allows the cap to go through the cap  
25 holding chamber 54.

26 [5100] The channel 56 extends between the cap feeding chamber 52 and the cap holding  
27 chamber 54. At the cap feeding chamber 52, the channel 56 extends beyond the cap feeding

1 chamber 52 and intersects the first end surface 86 of the base 50 to form an opening 90.  
2 Preferably, the bottom surface of the cap feeding chamber 52 is flush with the bottom surface  
3 of the channel 56 so that a cap disposed in the cap feeding chamber 52 can be pushed into the  
4 channel 56 towards the cap holding chamber 54. At the cap holding chamber 54, the channel  
5 56 does not extend beyond the cap holding chamber 54 so that a cap can only be fed to the  
6 cap holding chamber 54 from the channel 56 but not beyond cap holding chamber 54. The  
7 channel 56 has a cross section similar to the cross section of the caps 140. For example, the  
8 channel 56 in the illustrated embodiment has a rectangular cross section with its width  
9 similar to the diameter of the caps 140 and with its height similar to the height of the caps  
10 140. In this way, only one cap can be pushed into the channel 56 from the cap feeding  
11 chamber 52, and the channel 56 can accommodate only one cap at any particular position.

12 [5200] As illustrated in Figures 4, 5, 7 and 8, the shuttle 80 has a generally flat  
13 rectangular configuration. At least a portion of the shuttle 80 is movably disposed in the  
14 channel 56 of the base 50 through the opening 90 of the channel 56. The rest of the shuttle  
15 80 may be outside of the channel 56 or may also be disposed in the channel 56. Preferably,  
16 the cross section of the shuttle 80 is similar to or slightly smaller than that of the caps 140  
17 and that of the channel 56. Preferably, the cross section of the shuttle 80 is similar to or  
18 slightly smaller than that of the caps 140 and that of the channel 56. In the illustrated  
19 embodiment, the first end 92 of the shuttle 80 is outside of the channel 56 while the second  
20 end of the shuttle 80 is disposed in the channel 56. The shuttle 80 is movable within the  
21 channel 56 between a forward position and a back position. At the forward position, the  
22 second end 94 of the shuttle 80 is between the cap feeding chamber 52 and the cap holding  
23 chamber 54. At the back position, the second end 94 is between the cap feeding chamber 52  
24 and the opening 90 of the channel 56. When the shuttle 80 moves from the back position to  
25 the forward position, the second end 94 of the shuttle 80 pushes a cap in the cap feeding  
26 chamber 52 towards the cap holding chamber 54 by a distance substantially equal to the  
27 diameter of each of the caps 140. Preferably, the second end 94 of the shuttle 80 has a

1   semicircular configuration that conforms to the side surface of each of the caps **140**.

2   **[5300]**   As shown in Figures 1, 5 and 8, a piston-cylinder arrangement **100**, powered by  
3   compressed air, is connected to that portion of the shuttle **80** outside of the channel **56** (or  
4   any portion of the shuttle **80**) to move the shuttle **80** in the channel **56**. Alternatively, any  
5   linear or rotational actuator, such as an electric or hydraulic motor, may be used to move the  
6   shuttle **80** in a desired manner. Although not shown in the Figures, a shield or guard may be  
7   provided to cover the moving piston and/or the first end **92** of the shuttle **80** to protect the  
8   operator from injury. The cylinder **102** includes a forward chamber **104** and a back chamber  
9   **106**, which are separated by the piston **108**. Compressed air can be supplied either to the  
10   forward chamber **104** or to the back chamber **106** to move the piston **108** within the cylinder  
11   **102**. The supply of compressed air to the chambers **104**, **106** of the cylinder **102** is controlled  
12   by a four-way, two-position valve **110**, as shown in Figure 8. Compressed air can be  
13   supplied to the cylinder **102** from the nail gun **20** or from another source.

14   **[5400]**   The positioning of the valve **110**, thus the movement of the piston **108** and the  
15   shuttle **80**, is coordinated with the relative movement of the nail gun **20** and the cap feeding  
16   device **40**. The nail gun **20** and the cap feeding device **40** are pivotably attached to each  
17   other at a joint **150**. A spring **120** disposed between and connected to the nail gun **20** and the  
18   cap feeding device **40** normally biases the cap feeding device **40** and the nail gun **20** against  
19   each other and keeps the nose portion **32** of the nail gun **20** apart from the cap holding  
20   chamber **54** of the base **50**. When the base **50** is placed on a roof surface and the nail gun **20**  
21   is pressed towards the base **50**, the spring **120** is compressed, allowing the nose portion **32** to  
22   be positioned just above the cap holding chamber **54**. In this position, the nail gun **20** can be  
23   triggered to expel a nail through the opening **34** of the nose **32**.

24   **[5500]**   The coordination between the movement of the shuttle **80** and the relative  
25   movement between the nail gun **20** and the cap feeding device **40** can be explained while  
26   referring to the schematic drawing in Figure 8. The four-way, two-position valve **110**  
27   includes an air pressure port **112**, an exhaust port **114**, and forward and back ports **116**, **118**

1 connected respectively to the forward and back chambers **104, 106** of the cylinder **102**. At  
2 the first valve position **130**, the pressure port **112** is connected to the back port **118**, and the  
3 exhaust port **114** is connected to the forward port **116**. Compressed air is supplied to the  
4 back chamber **106** of the cylinder **102**, and the forward chamber **104** is connected to the  
5 exhaust port **114**. At the second valve position **132**, compressed air is supplied to the  
6 forward chamber **104**, and the back chamber **106** is connected to the exhaust port **114**.  
7 Normally, the nail gun **20** and the cap feeding device **40** are kept apart by the spring **120**, and  
8 the valve **110** is in the first position. At this position, compressed air is supplied to the back  
9 chamber **106**, and the shuttle **80** is in the back position. When the nail gun **20** is pressed  
10 towards the base **50** of the cap feeding device **40**, the spring **120** is compressed, and the  
11 spring **120** pushes the valve **110** into the second position **132**. At this position, compressed  
12 air is supplied to the forward chamber **104** and the shuttle **80** is moved to the forward  
13 position.

14 **[5600]** The operation of the nail gun assembly **10**, which includes the cap feeding device  
15 **40**, can be described while referring to Figures 1-8. If the cap container **60** is empty at the  
16 beginning of the operation, the plunger **70** can be lifted into the cover **68**, and the cover **68**  
17 can be placed in the open position. A stack of caps **140** attached to one another is disposed in  
18 the cap container **60**. The plunger **70** then is put back into the container **60**, and the cover **68**  
19 is placed in the closed position. If there are no caps in the channel **56** of the base **50** at this  
20 time, caps **140** can be fed into the channel **56**. To do so, the nail gun assembly **10** is placed  
21 on a surface such as a roof surface, and the nail gun **20** is pressed towards the base **50** to  
22 compress the spring **120**. The spring **120** then presses the valve **110** to put the valve **110** in  
23 the second valve position, and compressed air is supplied to the forward chamber **104** of the  
24 cylinder **102** and pushes the piston **108** to the forward position. The shuttle **80** is pushed to  
25 the forward position by the piston **108**, and the shuttle **80** pushes the cap in the cap feeding  
26 chamber **52** towards the cap holding chamber **54** by a distance equal to the diameter of one of  
27 the caps **140**. When the nail gun assembly **10** is lifted off the roof surface, the spring **120**

1 pushes the nail gun 20 and the cap feeding device 40 apart, and the valve 110 returns to the  
2 first valve position. The shuttle 80 is moved back to the back position and a cap is fed into  
3 the cap feeding chamber 52. This is repeated until the channel 56 is full of caps but a cap is  
4 not yet fed into the cap holding chamber 54. While doing this, the nail gun 20 need not be  
5 triggered to discharge a nail each time a cap is advanced in the channel 56. After a cap is  
6 loaded into the cap holding chamber 54, the nail gun assembly 10 is ready for use. The nail  
7 gun assembly 10 can then be placed on a piece of roof material, such as a piece of tarpaper,  
8 placed over a roof surface. The nail gun 20 is pressed towards the base 50. The shuttle 80  
9 moves to the forward position and pushes the cap in the cap feeding chamber 52 towards the  
10 cap holding chamber 54 by a distance equal to the diameter of the cap 140. Also, the cap  
11 next to the cap holding chamber 54 is pushed into the cap holding chamber 54. Then, the  
12 nail gun 20 is triggered to eject a nail through the opening 34 on the nose 32. The nail  
13 penetrates the cap in the cap holding chamber 54 and the tarpaper, and protrudes into the roof  
14 structure. The tarpaper is attached to the roof surface by the nail with a cap disposed between  
15 the tarpaper and the head of the nail. When the nail gun assembly 10 is lifted off the roof  
16 surface, the shuttle 80 moves back to the back position, and a cap is fed into the cap feeding  
17 chamber 52. Then, the nail gun assembly 10 is again ready for use.

18 [5700] Referring now to Figures 9a through 9h, the preferred embodiments of caps 140  
19 are illustrated. As illustrated in Figures 2 - 4, caps 140 are stored in cap container 60 to be  
20 singularly forwarded by cap feeding device 40 for installation. Caps according to the present  
21 invention have a configuration which facilitates the separation of an individual cap 140 from  
22 a stack and the feeding through the cap feeding mechanism 40 to ensure uniform supply of  
23 caps 140 and reliable operation of staple gun 20. Upper surface 142 of cap 140 includes a  
24 margin 146 disposed around the periphery of cap 140. Inwardly of margin 146 is a conical  
25 section 148 which slopes upwardly from the rim toward a top plateau 151 of the cap 140 at  
26 angle  $\alpha$  of preferably about 20 degrees from the horizontal plane of cap 140, although angles  
27 of from about 10 degrees to about 30 degrees are operable. The periphery of cap 140 is

1 defined by a side wall 154 and a bottom wall 156. Internally of bottom wall 156 is interior  
2 vertical wall 158 which terminates at a conical section 160 forming generally the  
3 undersurface of cap 140, conical section 160 proceeds centrally to a bottom plateau 162  
4 essentially parallel to top plateau 151 forming the remainder of the interior relatively concave  
5 surface of washer 140. In the illustrated embodiment of Figures 9c and 9d, a hole 164 is  
6 centrally located between top plateau 151 and bottom plateau 162. The function of hole 164  
7 will be subsequently described. Walls 154, 156 and 158 define a peripheral rim 168 being a  
8 circular band, the function of which will be subsequently described.

9 [5800] Roofing washer 140 illustrated in varying preferred embodiments in Figures 9a  
10 through 9h is specially adapted to be loaded into a magazine 60 for a roof nailing machine as  
11 is illustrated in the present invention. The inventive washer embodies several features which  
12 facilitate its being prepackaged in a stack of a convenient number, such as 100 caps for  
13 loading in such as magazine 60 to be singly fed through cap feeding device 40 in a reliable  
14 sequential manner providing the user of staple or nail gun assembly 10 an uninterrupted  
15 supply of caps 140 so long as there remain caps in magazine 60. Special features of cap 140  
16 which enable the exemplary service of the present invention are the lower peripheral rim 168  
17 which is formed by side wall 154, bottom wall 156 and interior wall 158. Peripheral rim 168  
18 provides stability to a stack of caps 140 such as illustrated in Figure 3 and facilitates the  
19 individual feeding of the caps 140 by shuttle 80 as illustrated generally in Figures 3 - 6 and  
20 additionally subsequently described. As previously stated, caps 140 are preferably about one  
21 inch in diameter and exhibit a general thickness of approximately 1/16th inch and composed  
22 of a plastic material well known in the art for such purposes. However, the vertical extent of  
23 cap 140 with the domed and rimmed construction stands approximately 1/8 inch above baseline  
24 B to top line T, because of the downwardly extending rim 168 and the conical dome formed  
25 by conical section 148 and top plateau 151. Upper surface 142 of cap 140 is composed of  
26 margin 146 which extends horizontally from side wall 154 toward the center of cap 140, a  
27 distance preferably at least twice the thickness of rim 168, which in the illustrated

embodiment is approximately 1/16 inch in thickness. Margin 146 provides the resting surface for a cap stacked immediately above it as is illustrated in Figure 10. Accordingly, margin 146 extends roughly 1/8th inch radially inwardly of side wall 154 to form a junction 147 and meets conical surface 148. As is illustrated in Figure 9d, conical surface 148 extends upwardly to top plateau 151 which describes a circular area of approximately 3/8 inch in diameter thereby forming a truncated cone. Correspondingly, the lower cap surface is preferably defined by conical section 160 which extends upwardly and inwardly from side wall 158 to a generally circular bottom plateau. In the illustrated embodiment, the diameter of bottom plateau 162 is approximately 7/16th inch. In the embodiment illustrated, it should be noted that the relative thickness of cap 140 adjacent junction 147 is less than elsewhere in cap 140.

[5900] Figure 10 illustrates the relationship of adjacent caps when stacked illustrating that upon stacking, bottom rim 168" of upper cap 140" provides spacing from the lower cap 140' such that the top plateau of bottom cap 140' is disposed adjacent and touching the bottom plateau 162" of upper cap 140 as the rim 168" of cap 140" rests firmly on the margin 146' of lower cap 140'. In such arrangement, the stack of caps 140 provide a stable vertical orientation so as to be conveniently packaged in a vertical stack of caps of a convenient number such as 100, the packaging of such a stack of caps being subsequently described.

[6000] Figure 11 illustrates the superior holding capacity of cap 140 when disposed on a roof surface 170 holding a layer of felt roofing paper 172 by means of nail 174. It will be seen that the entry of nail into the roof surface 170 draws the top and bottom plateaus of cap 140 downwardly toward roof surface 170 such that bottom plateau 162 engages roof felt 172 holding it firmly against roof surface 170. Concurrently as the general conical surfaces 148 and 160 are drawn downwardly by nail 174, the peripheral rim 168 also engages roofing felt 172 firmly because of the resilient nature of cap material 140. Accordingly, with cap 140 in position as illustrated in Figure 11, a secure holding of roofing felt 172 is accomplished on the roof surface 170. Cap 140 and nail may also be utilized to secure other building materials

1 such as polyethylene or Styrofoam sheeting.

2 [6100] Referring now to Figure 12, the function of the cooperating surfaces of cap 140 as  
3 a cap is urged off of the bottom of the stack of caps 140 by shuttle 80 will now be explained.

4 As shuttle 80 advances as indicated in the arrows, it feeds cap 140' laterally such that the rim  
5 168" of the cap 140" immediately above cap 140' slides along margin 146'. As may be seen

6 in Figure 12, the stack of caps 140 being contained within the tubular member 62 of

7 container 60, rim 168' of cap 140' clears the extent of tubular member 62 in a lateral

8 direction before the rim 168" of cap 140" reaches the innermost extent of margin 146'. The

9 relative dimensions of the various mentioned structural features of caps 140 enable the cap

10 140' being fed to clear the tubular member 62 in respect of rim 168' before rim 168" slides

11 up in the upper conical section 148' during the feeding process. By allowing leading edge of

12 cap 140' to clear tubular member 62 prior to the stack of remaining caps 140 within tube 62

13 having to accommodate the upper conical section 148, a smooth feeding transition and

14 sliding of the remaining caps through the upper cap 140" is accomplished. This combination

15 of relative movement of rim 168 on margin 146 and the conical surfaces 148 avoids

16 disjointed surfaces to enable the reliable consistent feeding of caps 140 by shuttle 80.

17 [6200] Because of the various previously mentioned surface features of caps 140 enable a

18 smooth, consistent, reliable feeding of a bottom cap in a stack through a feeding shuttle 80 as

19 illustrated, caps may be conveniently stacked through several inventive means. Cap 140

20 illustrated in Figure 9c containing hole 164 may be stacked and bound in a convenient

21 package by such as a line or wire traversing the stack of caps 140 as illustrated in Figures 13

22 and 14. In Figure 13 caps 140 are held together with a thermoplastic cord 180 such as is

23 utilized in plastic rotary lawn trimmers, *i.e.*, of the type sold under the trademark "Weed

24 Eater" owned by Aktiebolaget Electrolux. A plastic cord of a thickness of 0.050 to 0.065

25 inches in thickness are conveniently utilized. Such plastic cord is available in hardware

26 suppliers in such sizes. A suitable length of plastic cord 180 is fed through the stack of caps

27 140 to a degree where it exits the bottom of the stack of caps 140. A knob or knot of material

1 may be formed as at **182** at the lower reach of the stack of caps **140** to retain the caps on the  
2 plastic cord. Preferably the cord may be touched as with a hot iron to melt the thermoplastic  
3 cord **180** to form an enlarged portion or knob as at **182**, the enlarged portion having a  
4 diameter slightly larger than hole **164**. The stack of caps are thus securely retained on cord  
5 **180**. The cord may be conveniently terminated at the top of its extent by a convenient loop  
6 **184** as illustrated in Figure 13. The loop again may be formed as by tying or melting of the  
7 thermoplastic cord, as at region **186** as illustrated. When the caps are thus installed into  
8 container **60** of nailing machine **10**, the cap is directed into tube **62** and the top of the caps are  
9 pressed lightly off of the cord **180** into or towards the bottom of tube **62** which is then closed  
10 as described previously.

11 **[6300]** Figure 14 describes an alternative similar embodiment wherein the stack of caps  
12 **140** are held together with a metal wire in a manner similar to plastic cord in Figure 13. The  
13 wire is fed through the hole **164** of the stack tack of caps until it exists the bottom cap of  
14 stack of caps **140**. A retainer may conveniently be formed at the bottom end of wire **190**,  
15 may be terminated as at **192** by creasing the metal wire into such as a triangular shape as  
16 illustrated. Caps **140** are thus securely retained on wire **190** until such time as inserted into  
17 tubular member **62** in a manner as previously described. Wire **190** is conveniently  
18 terminated at the upper portion of the stack as by twisting or tying the wire forming a loop  
19 **194**.

20 **[6400]** A third alternative of assembling a stack of caps is illustrated in Figures 15 and 16  
21 by means of a cylindrical plastic tube **200** having a diameter just slightly larger than the  
22 diameter of caps **140**. Tube **200** is terminated at its lower end with such as flanges **202** to  
23 catch and retain caps **140** when inserted and stacked into tube **200**. The upper end of tube  
24 **200** may be terminated with a handle **204** such as illustrated or alternatively by a circular  
25 flange or the like similar to that illustrated in the lower portion of Figures 15 and 16, or in  
26 continuous circular flange. For added security, an adhesive label may be added over the top  
27 portion of tube **200** to ensure retention of the caps therein. On insertion of tube **200** into tube

62, tube 200 is withdrawn while maintaining pressure with stack of caps 140 such that flanges 202 are deformed to release caps 140.

[6500] Figures 9e and 9f and Figure 10 illustrate an alternative style of cap which may be stacked and retained in a stack without independent means as illustrated in Figures 13 through 16. Cap 140 in Figures 9e and 9f include a small stud 210 disposed on the top plateau 151 of cap 140. Stud 210 is centrally located on the top plateau 151 and in the illustrated embodiment is approximately 0.04 inches in diameter and extends upwardly from top plateau 151 in an amount approximately 0.40 inches. Bottom plateau 162 is adapted with a cooperating hole 212 into which stud 210 will be received when caps 140 are assembled in stacked relationship. Hole 212 in the illustrated embodiment is of a diameter slightly smaller than stud 210 being approximately 0.035 inches in diameter and the hole extends slightly greater depth than the height of stud 210 which in the illustrated embodiment is approximately 0.045 inches. Those skilled in the art will appreciate that the thickness and height of the described studs and cooperating hole may be varied in dimension without departing from the scope and spirit of the invention. Likewise, rather than a single centrally located stud and hole, other patterns might be selected with similarly suitable results such as offset pairs of triangularly or other locations about the center of top plateau 151.

[6600] Figures 9g and 9h illustrate further embodiment of caps 140 wherein the region between top plateau 151 and bottom plateau 162 is solid. Stacks of caps 140 may be formed in stacked relationship with such as the illustrated cap by means of a nominal amount of adhesive such as a drop of hot melt adhesive placed on the top or bottom plateau during a stacking operation whereby once the adhesive has cooled, the caps are retained in stacked relation. Other adhesives may likewise be employed with the limiting factor being that the sheer strength of the adhesive when applied to the caps shouldn't exceed the material strength of the caps such that the top plateau 151 and bottom plateau 162 are sheared or otherwise disfigured during the feeding operation. Deterioration of the top plateau 151 could result in irregular feeding of the caps.

1   **[6610]**     Figures 17-19 show a fourth alternative embodiment of assembling a stack of caps  
2   according to the present invention. A rigid retaining rod **220** or skewer passes axially  
3   through the caps **140**, **140a**, which are preferably like those shown in Figs. 9c and 9d,  
4   heretofore discussed in detail. Caps **140** have a first diameter axial hole **160** similarly-sized  
5   as the axial diameter of rod **220** so that rod **220** can be slid through the aligned axial holes  
6   **160** of the stacked caps **140**. The tip **222** of rod **220** has a reduced-diameter neck **224** that is  
7   frictionally received into the reduced-diameter axial hole **160'** of the bottom-most cap **140a**  
8   as the tip **222**, having a larger diameter than reduced-diameter neck **224**, is piercingly  
9   inserted through the reduced-diameter hole **160'** of the bottom-most cap **140a**. The resilience  
10   of bottom-most cap **140a** causes the bottom-most cap **140a** to be retained about the reduced-  
11   diameter neck **224** of rod **220** as the hole **160'** constricts about neck **224** after tip **222** has  
12   passed therethrough, thereby holding the stack of caps **140**, **140a** on the rod **220** until they  
13   are to be used.

14   **[6620]**     Rod **220** further has a grasping loop portion **226**. To use this fourth alternative  
15   embodiment, the stacked assembly of caps is lowered into the feeding tower or container of a  
16   cap gun. The user then grasps the portion **226** while holding the stacked assembly of caps  
17   within the cap gun as by using a finger or thumb, and the user then pulls the rod **220** from the  
18   stacked assembly of caps, thereby causing the tip **222** and reduced-diameter neck **224** to  
19   become disengaged from bottom cap **140a** as the entire rod is withdrawn from the stacked  
20   assembly of caps, which are left in the gun for subsequent dispensing and nailing by the gun.

21   **[6630]**     The use of a rigid retaining rod **220** as shown in Figs. 17-19 has an advantage  
22   over the use of thermoplastic cord as disclosed for the embodiment of Fig. 13, namely, that it  
23   is much easier to feed a rigid rod down through the caps during manufacture of the stacked  
24   assembly of caps than it is to feed a thermoplastic cord through the stacked assembly, thereby  
25   permitting faster assembly of the stacked caps. Additionally, during loading of the cap gun,  
26   the rigid rod holds the stacked assembly of caps more perfectly axially aligned because of the  
27   rigidity of rod **220** as compared to the flexibility of thermoplastic cord, thereby facilitating

1 the gun loading process and reducing loading time. If desired, the reduced-diameter neck  
2 **224** may be formed by cutting a circumferential groove around the end of rod **220** adjacent  
3 the pointed tip **222**.

4 **[6650]** Figures 20-24 show a fifth alternative embodiment of assembling a stack of caps  
5 according to the present invention. In this embodiment, the stacked assembly of caps **140** are  
6 held together by adjacent caps **140** being melted together at one or more places. Preferably  
7 the caps are melted together as by heating means such as a flame, a laser, hot air, or a heating  
8 element such as a soldering iron, preferably by having one or more melted portions **230** that  
9 run longitudinally along the circumferences of the stacked caps **140**. The caps **140**, being  
10 made of plastic material, melt when heated along melted portions **230**, thereby causing  
11 adjacent caps **140** to be meltingly held together.

12 **[6660]** To create this stacked assembly of caps **140**, the caps are preferably stacked  
13 within a sled **232** having a hinged lid **234** that opens for loading as shown in Fig. 23 and as  
14 shown in dotted outline in Fig. 22, with a well-known hinge **236** allowing hinged movement  
15 of lid **234** with respect to sled **232**. Longitudinal openings **238**, **240** in the sled **232** and/or lid  
16 **234** expose portions of the caps **140** to be melted to each other. A latch or hook **242** on the  
17 sled **232** engages with a well-known conveyor or chain **244** that transports the sled **232**  
18 carrying the caps **140** past upper and lower lasers **246**, **248** during manufacture. Lasers **246**,  
19 **248** respectively shine through openings **240**, **238** and respectively create melted portions  
20 **230** on the stacked caps **140** within the sled **232**.

21 **[6670]** The stacked assembly of caps **140** is thus retained together by the melted portions  
22 **230** and can be easily loaded into the feeding tower or container of a cap gun. As the gun  
23 dispenses each bottom-most cap, as by a reciprocating shuttle or the like, the plastic material  
24 of the melted portion holding the bottommost cap to the adjacent cap above will become  
25 broken, and the bottommost cap will become separated from the stacked assembly of caps  
26 and will be dispensed.

27 **[6680]** An advantage of this embodiment is that the stacked assembly of caps can be

1 easily removed as a unit from the feeding tower or container of the cap gun if the gun  
2 becomes jammed, so as to permit unjamming of the gun with subsequent reloading of the  
3 remaining caps of the stacked assembly. Other prior art solutions and other embodiments do  
4 not have this advantage that the caps remain held together in a stacked assembly when  
5 removed from the cap gun. A further advantage of this embodiment is that no rod or  
6 thermoplastic cord or string is required to hold the stacked assembly of caps together.

7 **[6700]** Various modifications may be made with respect to caps **140** and the stack  
8 retaining mechanisms without departing from the scope and spirit of the invention which is  
9 defined by means of the appendant claims. It is therefore to be understood that within the  
10 scope of the appendant claims the present invention may be practiced otherwise than as  
11 specifically described herein.